IN THE SPECIFICATION:

Please amend paragraphs [004], [006], [008], [009], [011], [012], [016], [053], [098], [099], [103], [108], [110], [111], [139], [144], [146], [150], [153], [156], [157], [159], [164]-[168], [171] and [173], as shown below, in which deleted terms are shown with strikethrough and/or added terms are shown with underscoring.

Paragraph [004]

An example of such devices for monitoring around a vehicle which extract~~s~~ an object, which may collide with the vehicle, from an image around the vehicle captured by an infrared camera is as follows. That is, in the device, the captured infrared image is subjected to a binary (2-level) thresholding process, and an area to which bright (white) portions are concentrated is searched for. Then, it is determined whether the area is a head portion of a pedestrian by using the aspect ratio (ratio of length to width) and the sufficiency rate of the area, and further calculating the distance between the vehicle and the area using the actual surface area and the position of the center of gravity in the image. If the area of the head portion of a pedestrian is determined, an area which forms the body of the pedestrian is determined by calculating the height of the pedestrian in the image based on the distance between the area determined to be the head portion and the camera, and an average height of an adult. These areas are displayed to be distinguished from the other regions of the image. In this manner, the position of the entire body of the pedestrian in the infrared image is determined, and this information is displayed for the driver so as to effectively assist the vision of the driver (refer to Japanese Unexamined Patent Application, First Publication No. Hei 11-328364, for example).

Paragraph [006]

Accordingly, since the barycentric coordinates of targeted objects, such as pedestrians, in the picture cannot be fixed with respect to the distance. Therefore, it is not possible to extract the targeted objects stably such as pedestrians which may collide with the vehicle, if the extraction is carried out based on the shape of at least the pedestrians' height, head, body as in the above-

mentioned conventional device.

Paragraph [008]

In order to achieve the above objects, the present invention provides a device for monitoring around a vehicle capable of detecting objects present around the vehicle based on an image captured by at least one infrared camera member provided with said vehicle such that said device comprises a pedestrian's head area calculating unit (for example, Steps S91 to S94 in the embodiment of the present invention) which establishes an area which is supposed to correspond to a head of the pedestrian as a reference area, a pedestrian's over-shoulder area calculating unit (for example, Step S95 in the embodiment of the present invention) which establishes two object areas which are supposed to correspond to over-shoulder areas of the pedestrian on both sides of the reference area, and a pedestrian's shape acknowledging unit (for example, Steps S96, S98, and S100 in the embodiment of the present invention) which ~~acknowledging~~ acknowledges the pedestrian who is in the captured image according to a feature in a luminance in the reference area~~s~~ and a feature in a luminance in the object areas.

Paragraph [009]

According to the device for monitoring around a vehicle described above, the device for monitoring around a vehicle establishes an area which is supposed to correspond to a head of a pedestrian as a reference area by a pedestrian's head area calculating unit due to a theory that the head of the pedestrian has a high luminance in an image which is captured by an infrared ray camera. Next, two object areas which are supposed to correspond to over-shoulder areas of the pedestrian are established on both sides of the reference area by the pedestrian's over-shoulder area calculating unit. By doing this, the pedestrian's shape acknowledging unit can ~~acknowledging~~ acknowledge the area which is supposed to correspond to the head and the shoulders of the pedestrian who is in the image which is captured by ~~an~~ the infra-red ray camera due to a theory that a the head of the pedestrian has a high luminance contrast with reference to a luminance contrast besides the head (background) in upward spaces ~~on~~ over the shoulders according to a feature in a luminance in the reference area~~s~~ and a feature in a luminance in the

object areas.

Paragraph [011]

In the device for monitoring around a vehicle which is provided with above structure, it is possible to prevent ~~the~~ an image which belongs to an area which is different from the targeted area from entering the targeted area because ~~the~~ of object incline in the infra-red ray image.

Paragraph [012]

A device for monitoring around a vehicle further comprises a pedestrian's shoulder area calculating unit (for example, Steps S97 and S99 in the embodiment of the present invention) which establishes ~~an~~other object areas for acknowledging the pedestrian's arms downwardly to the object areas, respectively, such that the pedestrian's shape acknowledging unit acknowledges the pedestrian in the captured image according to a feature in a luminance in the object areas and the other object areas.

Paragraph [016]

FIG. 2 is a perspective diagram showing positions of an infrared ray camera, a sensor, a display, etc., attached to a vehicle according to the embodiment of the present invention;

Paragraph [053]

After the center of gravity, the surface area, and the aspect ratio of the circumscribed square are calculated, and a process for tracking the object in relation to time, i.e., a process in which the same object is recognized every sampling period, is carried out (step S9). In the tracking process in relation to time, objects A and B are extracted at time k, which is obtained by discretization of analog time t using the sampling period, for instance, and it is determined ~~that~~ if objects C and D, which are extracted at time (k+1), are the same objects as the objects A and B, respectively. Then, if it is determined that the objects A and B and the objects C and D are the same objects, labels of the objects C and D are changed to label A and B, respectively, to carry out the tracking process in relation to time.

Paragraph [098]

Also, in step S46, if the height position Yt of the upper end of the object from the surface of the road is less than the threshold value TH5 (i.e., "YES" in step S46), it is determined whether or not the luminance dispersion Var_A3 of the mask area AREA3 is greater than the threshold value TH6 (in step S47). This process will be explained with reference to FIGS. 16A through 16C which show the luminance dispersion in the mask area AREA3 for the case where the object is a part or the ~~a~~ whole of a pedestrian, or a wall.

Paragraph [099]

As shown in FIG. 16A, when only a head portion of a pedestrian is extracted by the binary process using the width of the mask area AREA3 as the width of the binary object, difference in the degree of luminance is caused between the head portion and the lower half of the body portion. Also, as shown in FIG. 16B, when the entire body or at least the upper half of the body of a pedestrian is extracted using the binary thresholding method, difference in the degree of luminance is generated between the body portion of the pedestrian and the background. On the other hand, as shown in FIG. 16C, for the object in which the difference in the temperature is small ~~overall~~ over all the parts of the objects, such as a wall, difference in the degree of luminance is also small between portions extracted by the binary process and portions not extracted by the binary process. Moreover, the object is formed by portions of straight lines as in the AREA3. For this reason, the luminance dispersion Var_A3 in the AREA3 is high for a pedestrian, and low for an object, such as a wall.

Paragraph [103]

Also, in step S48, if the difference between the maximum value Max_Rate and the minimum value Min_Rate of the Rate, which indicates the ratio of the surface area between the circumscribed square and the binary object within a certain period of time, is less than the threshold value TH7 (i.e., "YES" in step S48), in the next step, it is determined whether or not there exists an area which is supposed to correspond to ~~be~~ a head of the pedestrian in an object

which is captured in an area AREA0 (Step S48-1).

Paragraph [108]

Also, if an area which is inferred to correspond to the shoulders and the arms of the pedestrian exists in the object which is captured in the area AREA0 in the step S48-2 (i.e., "YES" in the step S48-2), in the next step, the image processing unit 1 then carries out the pedestrian determination process for the shape of each extracted object in further detail.

Paragraph [110]

In step S50, if the height position Yt of the upper end of the object from the surface of the road is equal to or less than the threshold value TH8 (i.e., "NO" in step ~~S51~~ S50), the process proceeds to step S51 shown in the flowchart in FIG. 9. In step S51, it is determined if the width ΔWb of the binary object is equal to or less than the threshold value TH9, which is a value appropriate for the width of the body of a pedestrian) to determine if it is a lower half of the body of a pedestrian or a sitting pedestrian.

Paragraph [111]

FIG. 9 is a flowchart showing the procedure for distinguishing a pedestrian whose lower half of the body is extracted by the binary process or who is sitting. In step S51 of the flowchart, if the width ΔWb of the binary object is equal to or less than the threshold value TH9 (i.e., "YES" in step S51), it is determined whether or not the height ΔHg of the gray scale object is less than the threshold value TH10, which is a value appropriate for the height of a pedestrian, in order to determine if the object is a sitting pedestrian (in step S52). Optionally, after step S51, it may be determined whether it is raining around the vehicle. If it is raining, the process proceeds to step S54, while if it is not raining, the process proceeds to step S52.

Paragraph [139]

FIG. 13 is a flowchart showing a procedure for the case where the object is a plurality of pedestrians walking in parallel. If it is determined that the value of RATE, which is the ratio of

the surface area of the circumscribed square to that of the binary image within a certain period of time, is less than the threshold value TH22 in step S76 (i.e., "YES" in step S76), it is determined ~~that~~ whether the value of Asp, which expresses the aspect ratio of the circumscribed square for the binary object, is equal to or greater than the threshold value TH23 and is equal to or less than the threshold value TH14, i.e., the value appropriate for determining pedestrians walking in parallel (in step S77).

Paragraph [144]

In FIG. 17, it is detected whether or not there exists a head of the pedestrian by utilizing a feature in the luminance in each area in the image such that the pedestrian's head has a higher a luminance contrast than the luminance contrast in a background on both sides of the head. That is, as shown in FIGS. 18A and 18B, a projection area AREA4 is established (Step S91) in an area which is indicated "xh [m]" as a real space in an upper portion of an object area AREA 0 which is extracted as a gray scale image. After that, a luminance projection (a distribution of an integrated luminance in a horizontal direction which is formed by integrating the luminance in each pixel in a vertical direction) is calculated in a vertical direction (step S92) so as to detect a horizontal direction coordinate xCC which indicates a maximum peak with reference to an upper left reference point O (step S93).

Paragraph [146]

As shown in FIG. 19A, a reference area mask Mask_C is established (step S94) in an area which is inferred to correspond to a head position of the pedestrian with reference to the horizontal direction position xCC which is detected in the step S93. Simultaneously, ~~an~~ object area masks Mask_LT and Mask_RT for the object area 1 are established (step S95) which are inferred to correspond to a space above the shoulders in both sides of the pedestrian's head.

Paragraph [150]

In the step S96, if the pedestrian's head does not exist (i.e., "NO" in the step S96), the process goes to a step S49 shown in FIG. 8 because it is an identical to a case for "NO" in the step

S48-1 shown in FIG. 8. Thus, it is determined that the object which is captured in the area AREA0 is not a pedestrian (step S49); thus, the pedestrian determination ~~priecss~~ process is completed.

Paragraph [153]

Next, it is determined whether or not an area exists which indicates the shoulders and arms of the pedestrian by taking features of the luminance in each area (each section) in the image into account that the area which indicates the shoulders and arms of the pedestrian exists so as to be distant from the head by approximately the same distance from the position of the head and the luminance contrast of the shoulders and arms of the pedestrian is different from the luminance contrast in a background on both sides of the head which is positioned ~~on~~ above the shoulders of the pedestrian. In this manner, it is possible to further improve an accuracy for detecting the pedestrian. More specifically, as shown in FIG. 19A, other object area masks Mask_LU and Mask_RU as the object area 2 are establised (step S97) which correspond to the shoulders and arms under the object area masks Mask_LT and Mask_RT which are disposed ~~in~~ on both sides of the pedestrian's head which are used for determining a head in the step S96.

Paragraph [156]

Also, in the step S98, if the area which corresponds to the shoulders and arms of the pedestrian exists (i.e., "YES" in the step S98), the process goes to the next step S99.

Paragraph [157]

Here, in the step S98, it should be noted that a relativity error value between the object area masks Mask_LT and the ~~the~~ other object area masks Mask_LU is indicated by an Error_L so as to specifically compare the feature of the luminance in each area (each section) on the image. Also, a~~n~~ relativity error value between the object area mask~~s~~ Mask_RT and the the other object area mask~~s~~ Mask_RU is indicated by an Error_R. Consequently, the threshold values TH26 which are indicated below and the above relativity error are compared.

"Error_R" > TH26···(13)

"Error_L" > TH26···(14)

Paragraph [159]

Next, as shown in FIG. 20, two areas such as Mask_L and Mask_R are established as an object area 3 (step S99) therebeneath on both sides of the targeted object area AREA0 which is extracted as a gray scale image. Disparities for these areas (actual spatial distances) are calculated according to ~~a~~ stereo images which are disposed horizontally. Here, it should be noted that projected size for a W2_Space and a Mask_W1 indicate a designated size in the actual space.

Paragraph [164]

As explained above, in the device for monitoring around a vehicle according to the embodiment of the present invention, an object~~s~~ such as a pedestrian is extracted from the gray scale image which is captured by an infra-red ray camera by performing a binary process. After that, an area which is inferred to correspond to the pedestrian's head is establised as a reference area on the gray scale image which contains the binary object by the pedestrian's head area calculating unit. Consequently, the ~~a~~ pedestrian's over-shoulder area calculating unit establishes two object areas which are inferred to correspond to spaces above the shoulders of the pedestrian on both sides of the reference area upwardly.

Paragraph [165]

In this manner, the pedestrian's shape acknowledging unit acknowledges an area which corresponds to the head and shoulders of the pedestrian in an image which is captured by an infra-red ray camera by taking a feature into account that the pedestrian's head has a higher luminance contrast than the luminance contrast in a background which is on both sides of the head above the shoulders of the pedestrian.

Paragraph [166]

Furthermore, an object area which is inferred to correspond to an area above the shoulders of the pedestrian and another object area which is established by the pedestrian's shoulder area calculating unit so as to be inferred to correspond to the shoulders and arms of the pedestrian are compared. Thus, the area which corresponds to the shoulders and arms of the pedestrian in an image which is captured by an infra-red ray camera is acknowledged according to a theory that the luminance contrast in the shoulders and arms of the pedestrian is different from the luminance contrast in a background ~~in~~ on both sides of the pedestrian's head above the shoulders.

Paragraph [167]

Accordingly, it is understood that a distance for an entire pedestrian is equal to a distance to the shoulders and arms. Therefore, under the condition that the distance for the entire pedestrian and the distance to the shoulders and arms are compared, if a difference between the above distances is less than a certain value, the pedestrian's shape acknowledging unit can acknowledge that the binary object which contains the area which corresponds to the head and shoulders of the pedestrian and the area which corresponds to the shoulders and arms indicate a pedestrian.

Paragraph [168]

Accordingly, if the pedestrian is captured in an image which is captured by an infra-red ray camera in an inclining manner, an area which corresponds to the head and the shoulders of the pedestrian in which an outstanding feature of the pedestrian may be observed is detected from the image as the object by using the two object areas which are disposed above the reference area such that an area which is not ~~an~~ targeted area should not enter in the object area. Next, an area which corresponds to the shoulders and arms in which an outstanding feature of the pedestrian may be observed is detected. Furthermore, it is confirmed that a distance from an area which contains an entire pedestrian is equal to a distance from an area which corresponds to the shoulders and arms of the pedestrian. After that, it is acknowledged that the binary object which contains an area which corresponds to the pedestrian's head and the shoulders and an area which

corresponds to the shoulders and arms indicates the pedestrian. In this manner, it is possible to realize an effect in which it is possible to improve an accuracy for detecting the pedestrian.

Paragraph [171]

According to the device for monitoring around a vehicle in another aspect of the present invention, it is possible to prevent an image in an area which is different from the intended area from entering the object area by inclining the object in an image which is captured by an infra-red ray camera.

Paragraph [173]

According to the device for monitoring around a vehicle in still another aspect of the present invention, an object area which is inferred to correspond to the space above the pedestrian's shoulders and another object area which is inferred to correspond to the pedestrian's shoulders and arms which are established by the pedestrian's shoulder area calculating unit are compared with each other. Consequently, the pedestrian's shape acknowledging unit can acknowledge an area which corresponds to the pedestrian's shoulder and arms in an image which ~~are~~ is captured by an infra-red ray camera by utilizing a feature that the pedestrian's shoulders and arms have a different luminance contrast from the luminance contrast in a background on both side of the head.